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## Technical Report on Grant NAG 5-2976

Dear Dr. Oliverson:

I am writing to summarize the activities carried out under the above-referenced one-year grant. In accordance with our proposal, we carried out and analyzed a successful *Extreme Ultraviolet Explorer* spectroscopic observation of the BL Lacertae object Mrk 421 in April/May 1995 ( $\sim 242$  ksec useful time). During this period, the source underwent a flare that was detected also in simultaneous observations in the X-ray and TeV  $\gamma$ -ray energy bands. Our *EUVE* data, however, provided the best continuous coverage of the flare and therefore played a key role in the analysis of the multiwavelength observation campaign (Buckley et al. 1996).

Our spectral analysis benefited from an efficient procedure that we employed for properly assessing the background contamination at the shortest wavelengths. Furthermore, our observations were conducted in an off-axis mode ( $0.3^\circ$  offset in the plus X direction of the DS telescope), which shifted the SW spectrum from the on-axis value of  $\sim 70 \text{ \AA}$  down to  $\sim 65 \text{ \AA}$ . As a result, we were able to identify strong absorption features at the shortest observed EUV wavelengths ( $\sim 65 - 75 \text{ \AA}$ ), which were missed in earlier, on axis *EUVE* observations that extended only down to  $\sim 75 \text{ \AA}$  (Fruscione et al. 1996). The inferred absorption is quite similar to that detected previously in our *EUVE* observation of the BL Lac object PKS 2144-304 (Königl et al. 1996), as can be clearly seen by comparing the two spectra in their respective rest frames (see Fig. 3 in the enclosed reprint). This has bolstered our confidence in the reality of the apparent absorption features and has strengthened the case for their generality. We have demonstrated that these features can be attributed to a superposition of Doppler-smearred absorption lines originating in high-velocity ( $\sim 0.05 - 0.1 c$ ), QSO-type clouds of total column density  $\sim 5 \times 10^{21} \text{ cm}^{-2}$  that are ionized by the beamed continuum of the associated relativistic jet. We identified the lines as mostly L- and M-shell transitions of Mg and Ne. These results are very similar to

the ones we obtained in our earlier observations of PKS 2155-304. We have argued that, in both cases, we may be seeing clouds that are carried up by a magnetized outflow from the surface of a nuclear accretion disk until they enter the beamed emission cone of the jet, whereupon radiation pressure further accelerates them to their final velocities.

Our observations and interpretation of Mrk 421 were described in Kartje et al. 1997 (see attached reprint). The results were also presented in a poster at the AGN session in the 18th Texas Symposium on Relativistic Astrophysics (Chicago, December 1996). Our interpretation of the observations has formed the basis for a unified model of outflows in BL Lac objects and Broad Absorption Line QSOs (Kartje & Königl 1997). Preliminary accounts of this work, which have included a description of the *EUVE* observations of BL Lac objects, were presented in posters in IAU Colloquium No. 163 on Accretion Phenomena and Associated Outflows (Port Douglas, July 1996) and in the Carnegie Observatories Workshop on Ejection of Matter from AGNs (Pasadena, February 1997).

The funds provided by the grant were used to support the work of J. Kartje at Chicago and to cover the publication costs of the Kartje et al. (1997) paper.

#### References:

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Sincerely,

Arieh Königl

Enclosure: reprint